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Effect of Using L–Threonine and Reducing Dietary Levels of Crude Protein on Egg Production in Layers

Research Article

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ABSTRACT

This experiment was conducted to determine the effect of using L-threonine and reducing dietary levels of crude protein (CP) on egg production criteria in layers. Three hundred of Hy-Line W36 laying hens were used in this experiment. This experiment consisted of three experimental treatments with five replications in each. Experimental treatments included 3 diets with different levels of CP which were 15, 16 and 17% with 0.1, 0.05 and 0.02% L-threonine supplementation, respectively. Experimental period lasted for 5 weeks. In this experiment quantitative factors such as egg mass, egg weight, egg production percentage, feed conversion ratio (FCR), body weight and feed intake were measured. Measured data were analyzed by completely randomized design (CRD). Results indicated that reducing dietary levels of CP to 15% and using L-threonine supplementation had no significant effect (P>0.05) on laying criteria. According to economic analysis, the treatment containing 15% CP and 0.1% L-threonine was the most beneficial treatment.

KEY WORDS economic analysis, egg production, layers, low CP diet, L-threonine.

INTRODUCTION

The cost of protein and energy has fluctuated dramatically for the feed industry during the last few years. Therefore, feed formulation practices are directed toward economic analysis rather than optimal bird performance (Kidd and Kerr, 1996).

The industrial production of methionine and lysine has resulted in reducing the level of dietary CP by poultry nutritionists while maintaining bird performance and profitability. Indeed, the commercial availability of other amino acids may allow nutritionists to further decrease CP while more effectively meeting the birds' amino acid requirements for maintenance and tissue accretion (Kidd and Kerr, 1996).

Waldroup (2000) could reduce the dietary level of CP dramatically by using synthetic amino acids.

The other problem that producers are faced is heat stress. Since the metabolism of proteins in body is very calorific, in heat stress condition will be resulted in birds' performance depression. A study was conducted for evaluating the effects of methionine in low CP diets on performance of production, productive system, abdominal fat and chemical conditions of layers' liver in hot weather. The results showed that supplementing low CP diets by methionine in hot weathers was an advantage and resulted in improvement in birds' performance (Bunchasak and Silapasom, 2005).

One of the other amino acids that are produced synthetically is L-threonine supplementation. Threonine is the third limiting amino acid in corn-soybean meal poultry rations (Kidd and Kerr, 1996).

An experiment was conducted to determine the dietary interactions between lysine and threonine in broilers. Results indicated that there was no interaction between threonine and lysine (Kidd *et al*. 1997).

The most important problem, which is associated with animal and poultry industry, is excretion of high amounts of nitrogen (N) to environment. Where there are not enough fields as the most common places for using poultry manure, this large amount of produced nitrogen will leach in groundwater. By reducing the dietary CP levels, the amount of excreted N will be reduced, so the risk of environmental contaminations will be declined. Ferguson (1998) reported that N excretion could be declined to 16% by reducing the dietary CP level to 2%. An experiment was conducted to determine dietary interactions between threonine and crude protein in diets for growing Tom turkeys 8 to 12 weeks of age. Regarding FCR and gain body weight, there was not any significant interaction between dietary CP and threonine levels. The performance of birds that were fed low CP diets was excellent (Waldroup, 2002).

The aim of this study was determination of layers' responses to reducing dietary CP levels and using L-threonine supplementation

MATERIALS AND METHODS

Three hundreds of Hy-Line W36 laying hens at 65 weeks of age were used in this study. They were placed in 60 high raised laying batteries. Sixty batteries were divided into 3 experimental treatments and each treatment was consisted of five replications. Experimental treatments included 3 different kinds of diets which included 15, 16 and 17% CP and 0.1, 0.05 and 0.02% L-threonine supplementation, respectively. Diets were formulated by UFFDA software and were made weekly. The formulas and calculated analysis of diets are presented in table 1 and table 2. The average temperature was 25 ºC and birds were reared under 16 h lighting and 8 h darkness. This experiment was based on completely randomized design and collected data were statistically analyzed by SPSS software. Statistic model of this study was:

$$Y_{ij} = \mu + t_j + \varepsilon_{ij}$$

Weight of all 300 birds was measured at the beginning and the end of experimental period to see if their weight has changed. All produced eggs were collected twice a day and their number and weight was measured and recorded. In this way, percentage of production, average egg weight and egg mass was calculated. All birds fed fixed amount of feed feed daily and after 24 hours ort feed was recorded separately in each treatment. Feed intake and FCR were evaluated. Economic analysis were done by calculating the cost of production (just the cost of feed were put in account and other costs were not considered) and price of produced egg.

Table 1 Formulations of experimental diets (%)

Ingredients	15% CP	16% CP	17% CP
Corn	63.1	60.16	57.04
Soybean meal (44%)	21.44	24.15	26.9
$CaCO_3$	11.64	11.63	11.61
DCP	1.48	1.46	1.88
Oil	0.91	1.37	1.45
Vit. and Min. Premix	0.5	0.5	0.5
$NaHCO_3$	0.4	0.26	0.15
DL-Methionine	0.21	0.19	0.16
L-Lysine	0.1	0.01	-
L-Threonine	0.1	0.05	0.02
Salt	0.12	0.22	0.29

Table 2 Calculated nutrient contain of experimental diets

Nutrients	15% CP	16% CP	17% CP
ME (kcal/kg)	2670	2670	2670
CP (%)	15	16	17
Met (%)	0.44	0.43	0.42
Met + Cys (%)	0.7	0.7	0.7
Lys (%)	0.82	0.82	0.87
Thr (%)	0.66	0.66	0.66
Ca (%)	4.45	4.45	4.45
P (%)	0.44	0.44	0.44
Na (%)	0.18	0.18	0.18
K (%)	0.61	0.65	0.70
Cl (%)	0.12	0.16	0.20
DCAB (meq/kg)*	200	200	200
CF (%)	2.69	2.8	2.96
Linoleic acid (%)	1.56	1.61	1.67

*Dietary Cation-Anion Balance(Na+K-Cl).

RESULTS AND DISCUSSION

After analyzing collected data and statistically comparison, results indicated that there was not any significant difference between experimental treatments.

Table 3 Effect of experimental diets on performance of laying

Treatments	Egg production (%) EP	Egg mass (g) EM	Egg weight (g) EW	Feed intake (g) FI	FCR
15% CP	80.28	7118	64.02	1900.608	1.86
SEM	0.630	79.019	0.586	27.568	0.023
16% CP	79.37	7013	63.96	1919.54	1.92
SEM	1.671	143.721	0.489	18.507	0.028
17% CP	79.04	7113	64.48	1882.976	1.86
SEM	0.833	87.869	0.285	25.697	0.024

FCR: feed conversion ratio.

Percentage of egg production in treatment, which contains 15% CP and 0.1% L-threonine was partially more than other treatments, however, there was not any significant difference between treatments (Table 3). This result was similar to the results of previous research (Harms and Russell, 1993; Hsu *et al*. 1998).

Egg mass was calculated by measuring the weight of all daily produced eggs. Although, there was not any significant difference between experimental treatments, egg mass of treatment containing 15% CP and 0.1% L-threonine supplementation was partially higher than other treatments (table 3). This result was similar to the result of previous research (Harms and Russell, 1993).

Analyzing egg weights showed that the weight of produced eggs in treatment containing 15% CP and 0.1% L-threonine was a bit lower than other treatments. However, there was not any significant difference between treatments (Table 3). This result was similar to the result of previous research (Keshavarz and Jackson, 1992; Leeson and Caston, 1996).

Results of feed intake indicated that there was not any significant difference between experimental treatments (Table 3). These results are similar to the result of previous research (Keshavarz and Jackson, 1992).

FCR was calculated by (feed intake/egg mass)×100, and no significant difference between treatments was observed (Table 3). This result was similar to the result of previous research (Leeson *et al*. 1998).

For evaluating the difference of birds' weight at the end of experimental period, they all were weighted at the beginning and the end of period to see if they have lost or gained weight. Analyzing data showed that there was not any significant difference between treatments (Table 4). Birds fed diet containing 15% CP and 0.1% L-threonine supplementation had no change in body weight, but the birds fed other diets partially gained weight. Result of this study was similar to the result of other's research (Hussein, 2000).According to economic analysis, the treatment containing 15% CP and 0.1% L-threonine supplementation was the most beneficial treatment (Table 5).

Table 4 Laying hen body gain in response to treatment (g)

Treatment	Weight gain
15% CP	0.0
16% CP	+19.5
17% CP	+26.0

Table 5 Economical analysis (USD)

Treatments	Cost of Feed*	Price of Egg*	Cost of production of 1kg of egg*	Revenue of selling 1kg egg*
15% CP	0.296	0.763	0.549	0.213
16% CP	0.297	0.763	0.571	0.192
17% CP	0.301	0.763	0.560	0.203

*Cost of production includes only feed cost and other costs (e.g. labor, fuel, etc.) are not considered.

CONCLUSION

Results indicated that reducing dietary level of CP and using L-threonine supplementation had no negative effect on quantitative laying production. Economic analysis showed that using L-threonine supplementation and reducing dietary level of CP to 15% would increase the benefit at the finishing period of production.

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